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Bottom Hydroacoustic Test Ranges for Earthquake Prediction

[Article by Yu. M. Kazymov; UDC 551.24:534.6]

[Abstract] It is proposed that a system be developed for predicting earthquakes on the sea floor on the basis of the Pevnev geodetic method for predicting large crustal earthquakes and the Lobkovskiy model for subduction zones. The geodetic prediction method is used in the zone of an active fault by constructing geodetic profiles with subsequent periodic interrogation. The predictive criterion is the exponential curvature of rocks, thereby making possible determination of the length and width of the focus and the rate of accumulation of elastic deformations. In the proposed variant, whose structure is described in detail, the principles of bottom hydroacoustic ranging are applied with allowance for seasonal water mass changes, presence of bottom currents and influence of other factors. Particular attention is given to ways to ensure longevity of the system. A model of a hydroacoustic polygon is proposed which can be used in laying out a predictive test range. It is laid out in two stages. First a fault zone is covered by a network of hydroacoustic polygons for detecting places of cessation of movement along the fault. With detection of such a place the network is supplemented by a profile running across the fault strike with an increase in the number of measurement points in the zone near the fault. Measurements need be made only each two or three years in order to obtain predictive evidence. The measurement data can be transmitted to a special buoy and then to a satellite or ship. It is acknowledged that such work would be very costly. Figures 3; references 7 Russian.

Plate Tectonics Hypothesis: Progress or Regression in Geology? 1. Spreading and Subduction. All a Myth

[Article by E. S. Motorenko, St. Petersburg University; UDC 551.24]

[Abstract] Modern arguments for and against the plate tectonics hypothesis can hardly be regarded as discussions because scientists are not listening to one another. This is especially true of supporters of the hypothesis, who for decades have largely ignored their opponents. Until now no explanations from the viewpoint of plate tectonics have been given for the origin of anteclises and syneclises on platforms over the course of hundreds of millions of years, the stages and cycles of development of geosynclines, the nature of development of Neogene-Quaternary orogens in time and space. Thirty years have elapsed from the beginning of development of the hypothesis and many of its precepts remain postulates. It

was therefore deemed important not only to illustrate by geological materials its inability to explain real facts, but also to demonstrate the degree of reliability and soundness of its principal points, the basis on which it is founded. Such is the emphasis in this article. It is shown that the two principal cornerstones without which the new global tectonics is impossible, spreading and subduction, not only have not been confirmed, but on the contrary have encountered still more obstacles, including from marine geology and geophysics. From the very beginning being speculative, these concepts have received no specific proof, remaining a myth, far from reality. References 15: 14 Russian, 1 Western.

Seismogeodynamic Activation Waves and Long-Range Earthquake Prediction

[Article by V. I. Ulomov; Earth Physics Institute imeni O. Yu. Shmidt. Russian Academy of Sciences; UDC 550.343]

[Abstract] Stable and long-lived deformation waves migrating singly along intrablock sutures in the lithosphere were detected as a result of investigations of ordering of regional structures of seismicity and the development of seismic processes. These are unusual geosolitons (given the name geons) which play an important role in the direction of development of seismogeodynamic processes. Geons are capable of existing a long time (years and decades) and propagating along fault zones for considerable distances (hundreds and thousands of kilometers). Precisely due to these geons there is movement of the sides of extended faults whose movement as an entity is impossible. Geons, seemingly by parts successively displacing the sides of the faults, favor the movement of regions of elastic stresses and strains, and therefore rock masses, for enormous distances. Geons are not hypothetical waves diverging in circles or any other deformational phenomena in the asthenosphere or lithosphere postulated by other researchers. The geological sense of geons is a self-organizing dislocation creep along faults caused by mechanical interaction of release waves at earthquake foci and creep movements along existing faults under conditions of universal deformation of the lithosphere. Geons afford new possibilities for studying the structure of seismicity, identification of seismotectonic relationships, discrimination of seismic-generating zones and potential foci of earthquakes, for long-range prediction of seismic conditions and for compiling maps of seismic zoning of a new type. The flow density of seismic events within the limits of a moving geon can serve as a basis for evaluating the probability of occurrence or nonoccurrence of the next earthquake of a given magnitude within the limits of a specific region of seismic activation. Figures 5; references 37: 21 Russian, 16 Western.

Aftershocks of Powerful Underground Explosion in Inhomogeneous Medium

[Article by A. A. Spivak, Institute of Dynamics of Geospheres, Russian Academy of Sciences, Moscow; UDC 550.34+622.235]

[Abstract] Data are given on the aftershock emission induced by an underground nuclear explosion on 8 July 1989 in the Balapan rock complex in Eastern Kazakhstan, an area with complex structural and tectonic features. The shot area contains a number of large and small tectonic dislocations breaking the bedrock basement into tectonic blocks of different order, but there is one major first-order (regional) deep tectonic dislocation. A knowledge of the character of aftershocks in such a medium, associated with relaxation processes, is useful in monitoring underground nuclear explosions. These aftershocks are observed over a prolonged time after such an explosion, facilitating in situ monitoring. Measurements were made at nighttime when external noise was minimal. Two methods were used: correlation analysis of data from spatially separated seismic registry stations and analysis of records obtained at a central point by three-component registry and at peripheral points by single-component registry. The presence of a major deep fault resulted in a substantially nonuniform spatial distribution of aftershock foci. Diagrams are given showing the azimuthal and depth distributions of the aftershock foci of the studied explosion. The overwhelming majority of the aftershock foci were concentrated in the structural block in which the explosion was set off. A deep fault is clearly manifested in the form of a boundary beyond which the relaxation processes induced by the explosion transpire less effectively than in the principal block. This means that the fault impedes transfer of the explosion energy and as a result, in the structural block separated from the explosion there is no additional reserve of elastic energy and the disturbance from the explosion is insufficiently great for inducing the freeing of the tectonic energy initially present in the medium. Figures 4; references 11: 10 Russian, 1 Western.

Results of the Prediction of Earthquakes in the Caucasus Region

[Article by L. I. Tuliani; UDC 550.343.4+624.131.551.1]

[Abstract] This method of predicting the coordinates of seismically dangerous points and zones in seismically active areas is based on thermomechanical parameters at various levels of the crust, stratification of the crust into friable and viscous layers, the reaction of the crust as a whole to external forces and temperature, and gravithermomechanical interaction of friable and viscous layers when there are extreme effects on them. Four seismically dangerous zones have been isolated, and the method has been tested in these zones since 1988. As an example, in Armenia (between 7 December 1988 and 4 March 1991) and Georgia (between 29 April 1991 and 6 November 1992) 92.7% of the earthquakes occurred at predicted coordinates with a difference between the predicted and actual coordinates of up to 10 km. The article presents lengthy tables listing predicted and observed coordinates of earthquakes in Armenia and Georgia. The author presents proof of predictions of the coordinates of large earthquakes which have occurred in these regions since 1988. The method may be used for long-range (3-5 years) prediction of the coordinates of earthquakes in any seismically active region of the Earth. Tables 3; references 3 (Western).

Long-Range Weather Forecasts

[Abstract] There is basis for assuming that during the
coming decades empirical-statistical methods will serve
as the basis for long-range forecasts. All such methods
must be reexamined in order to systematize them and
raise their quality to the possible limit. All known
long-range prediction methods and procedures used for
the territory of the former Soviet Union must be col-
lected, checked and revised and then an optimum pro-
cedure for their integration must be developed. Only a
limited increase in quality and reliability can be
expected from this undertaking. Greater attention must
be given to optimum data averaging periods. The com-
monly employed monthly averaging period is too great;
10- and 15-day averaging periods also must be
employed. The commonly used 30-year climatic means
must definitely be revised. The sec   al averaging periods
also must be reconsidered. Efforts must be made to
optimize data archives, making them minimum in
volume and maximum in content. The regions exerting
the strongest influence on the areas for which predictions
are made must be defined more accurately. The possi-
bilities of classical correlation analysis in the long-range
forecasting field have not yet been entirely exhausted. It
is probable that the most promising way to develop
long-range weather forecasts is by a changeover from
predictions of general circulation of the atmosphere and
its different links to predictions of weather elements
since only in this way will it be possible to achieve a
maximum prediction period and a greater forecasting
reliability. The direct application of the equations of
hydrodynamics for long-range computation of the state
of the atmosphere is impossible due to the loss of
predictability of small-scale processes. The article makes
no pretense at being a history of development or a review
of long-range forecasting methods used in Russia,
instead being a concise analysis of the state of the art and
an attempt to evaluate possible perspectives. It is based
on much well-known material and no references are
given. Figure 1.

Nonstationary Vortical Motions in Ocean

937N0084A Moscow OKEANOLOGIYA in Russian
Vol 32 No 6, Nov-Dec 92 pp 997-1004

[Article by A. I. Ginzburg, Oceanology Institute imeni P.
P. Shirshov, Russian Academy of Sciences; UDC
551.465:629.78]

[Abstract] The typical elements of nonstationary vortical
dynamics in the ocean detected on the basis of satellite
information are reviewed. These include vortex streets,
monopoles and dipoles of different nature. The spatial-
temporal and kinematic characteristics of different types
of vortices of different scales are presented, the mecha-
nisms of their formation are examined and their general
characteristics are clarified. These formations cover a
broad spectrum of spatial scales (frequently from small
to synoptic), have a regular configuration and a shear
(barotropic) origin. It is emphasized that the formation
of dipoles due to the presence of associated eddies on the
periphery is a regular occurrence in the evolution of an
isolated vortex. It is possible for asymmetry to exist in
the capacity of anticyclones and cyclones to form such
structures. The formation of associated eddies is evi-
dently typical not only for rings, but also for large-scale
anticyclonic vortices of different nature, as is illustrated
in the example of an anticyclone with L = 60 km with a
core of well-expressed cyclones in the northeastern and
northwestern sectors of the periphery (and possibly still
another less clearly expressed cyclonic vortex in the
southern sector). The vertical scale of such vortical
formations in many cases is limited by the near-surface
layer due to sharp density stratification on its lower
boundary. It is postulated that many of the examined
types of movements also are formed in deep layers, but
this must be confirmed by further research. A table lists
the seven types of formations discussed in the text
(chains of shear eddies; individual spiraling eddies in
open ocean; eddies associated with islands; eddies
formed due to shoreline irregularities; eddies in places of
divergence or convergence of currents; mushroom-
shaped eddies; associated eddies). Figures 2; references
21: 12 Russian, 9 Western.

Some Features of Intrathermocline Lens on Subpolar Front in North Atlantic

937N0084B Moscow OKEANOLOGIYA in Russian
Vol 32 No 6, Nov-Dec 92 pp 1012-1018

[Article by V. I. Byshev, Oceanology Institute imeni P. P.
Shirshov, Russian Academy of Sciences, Moscow; UDC
551.46]

[Abstract] Intrathermocline lens (ITL) AK-50, the core
of an intrathermocline eddy (ITE), was discovered on the
subpolar front in the North Atlantic in June 1990. It was
formed in the layer 500-1000 m and was adjacent to the
frontal surface to the east of the front, forming as a result
of hydrodynamic processes in the frontal region. The
ITE had anticyclonic rotation and moved in space in
conformity to the circulation of waters in the frontal

zone. AK-50 is different from ITL of Mediterranean
origin and it is postulated that the most probable mech-
anism of its formation was winter convection. It is
bounded upward by the thermocline and downward by
the pycnocline. A detailed study was made of the vertical
structure of these ITL waters to estimate the orders of
magnitude of anomalies of heat and salt content in its
section and to analyze the field of speed of sound and
hydrochemical properties. The analyzed data provided
clues to the genesis and evolution of the ITL and ITE and
for estimating their age and lifetime. The analysis gives
basis for assuming that in the neighborhood of the
subpolar front in the North Atlantic there is a vertical
exchange process between the surface and deep layers as
a result of which heat, salt and oxygen enter into the deep
layers of the ocean and this vertical exchange process
unquestionably must play a definite role in the forma-
tion and variability of oceanic climate. Figures 2; refer-
ences 5: 4 Russian, 1 Western.

Temperature Features of the Black Sea From Satellite and In-Situ Measurements in Winter

937N0091A Moscow ISSLEDOVANIYE ZEMLI IZ
KOSMOSA in Russian No 2, Mar-Apr 93 pp 3-10

[Article by G. A. Grishin, Ye. I. Kalinin, S. V. Motyzhev,
V. V. Pustovoytenko, V. P. Yastreb, Marine Hydrophys-
ical Institute, Ukrainian Academy of Sciences, Sevas-
topol; UDC 551.501:628.78]

[Abstract] Most NOAA surveys of sea surface tempera-
ture have been conducted in the warm part of the year
and in regions of small seasonal variations in sea surface
temperature. This article discusses the results of sea
surface temperature reconstruction in a large hydrolog-
ical test site in winter. The data of the AVHRR radiom-
eter (APT mode) on the NOAA satellite, a towed surface
temperature measurement device, STD sensor, and two
drifting LOBAN-TM buoys are analyzed. Measurement
and data processing methods are described. Maps of
spatial distributions of sea surface temperatures are
compared. An attempt is made to evaluate the effective-
ness of the methods used by analyzing comprehensive
surveys of the Black Sea. The accuracy of reconstruction
of the sea surface temperature field from satellite data is
evaluated on the qualitative level. No unambiguous
conclusion can be reached about the complete reliability
of sea surface temperature structure reconstruction,
mainly due to the fact that the representativeness of the
constructed field is dependent on the averaging scale.
Figures 5; table 1; references 12: 11 Russian, 1 Western.

Evaluation of Sea Surface Temperature Fluctuation Parameters at the South Shore of Crimea Using Satellite Observational Data

937N0091B Moscow ISSLEDOVANIYE ZEMLI IZ
KOSMOSA in Russian No 2, Mar-Apr 93 pp 11-18

[Article by V. A. Ivanov, Yu. P. Ilin, Marine Hydrophys-
ical Institute, Ukrainian Academy of Sciences, Sevas-
topol; UDC 551.46.08:629.78]

[Abstract] It is shown that processing of a set of sea surface temperature maps obtained in the course of satellite monitoring of the Black Sea in summer 1991 makes it possible to isolate four main empirical modes of spatial and temporal variability of temperature anomalies in the region of the south shore of the Crimea. The results satisfy dispersion equations for barotropic and baroclinic instability of the main Black Sea current and confirm estimates made earlier based on in-situ measurements. Figures 3; references 8: 7 Russian, 1 Western.

Numerical Computations of Nonstationary Nonlinear Wave Processes in Vertically Stratified Fluid

[Article by V. L. Izergin, Pacific Ocean Oceanological Institute, Far Eastern Department, Russian Academy of Sciences, Vladivostok; UDC 551.466]

[Abstract] In the study of the nonlinear theory of wave motion in a stratified fluid, despite the great number of instabilities in the slightly nonlinear models which are often used, numerical computations using precise hydrodynamic equations are used extremely rarely because computations made using these equations require many computation resources (computer time and memory) and precise solutions may contain a great many different phenomena, not all of which are of interest. A new method is proposed for computer-aided numerical solution of the equations of hydrodynamics of an ideal incompressible stratified fluid in a gravity field. A curvilinear coordinate system in which the vertical coordinate is Lagrangian and the horizontal coordinate is Eulerian is used. Specifically, by a special replacement of variables the number of equations and unknowns is decreased to two in the case of two-dimensional fluid motion. In addition to convenience in computations, the new formulation of the equations of hydrodynamics differs from the traditional formulation in that in an explicit form it contains a continuous set of additional (other than energy) integrals of motion. The possibilities of the proposed computation scheme are demonstrated in the example of numerical computations of the formation of an internal bore in the near-bottom thermocline. The results are consistent with observational data. Figures 2; references 16: 13 Russian, 3 Western.

Spectral Analysis of Fine Thermohaline Structure of Arctic Basin Active Layer

[Article by V. V. Lukin and D. A. Pavlikov, Arctic and Antarctic Scientific Research Institute, St. Petersburg; UDC 551.465]

[Abstract] The results of spectral analysis of the fine thermohaline structure of the waters of the central part of the Arctic Basin, little information on which has been available, are discussed. The observations were made using a precision CTD probe on one of the "Severnyy polyus" drifting stations in 1988-1989. An analysis of the form of the spectra of fluctuations of thermohaline characteristics indicated that the active layer spectrum is a complex superposition of the spectra of the upper quasihomogeneous layer, halocline and thermocline, having a different form attributable to a predominance of different structure-forming processes. For the most part the values of the spectral density function decrease with an increase in the wave number, except for the temperature spectra of the upper quasihomogeneous layer and halocline which have peaks at wavelengths 2 and 4 m respectively. The stability of the form of the spectra of the fine structure of the halocline and thermocline and the small dispersion of values of the spectral function of the fine structure of the active layer indicate a stability of the processes of structure formation and the hierarchy of these structures within natural layers. This makes it possible to conclude that the development of statistical models for predicting the fine stratification of Arctic Basin waters is promising. Figures 3; references 7: 4 Russian, 3 Western.

Frequency of Recurrence of Heights of Internal Waves in Mediterranean Sea

[Article by V. A. Ivanov, Ye. N. Pelinovskiy and T. G. Talipova, Marine Hydrophysics Institute, Ukrainian Academy of Sciences, Sevastopol; Applied Physics Institute, Nizhniy Novgorod; UDC 551.465]

[Abstract] Data on the frequencies of recurrence of the heights of internal waves were obtained for a number of regions in the Mediterranean Sea, especially on the Egyptian shelf, in an area where depths ranged between 200 and 1100 m, in July 1991. These data are approximated well by a Poisson distribution and were compared with those obtained earlier for the Atlantic Ocean. It was found that the wave regime is poorer in the Mediterranean Sea, so that the probability of recurrence of large internal waves there is lower. The difficulties in theoretical interpretation of the parameters of the Poisson distribution are discussed. This analysis of the frequencies of recurrence of the heights of internal waves made it possible to confirm the Poisson statistics for this phenomenon. A variant of the theory using the mean Vaisala frequency is proposed for describing the statistics of long waves. It was validated by data from multihour observations of internal waves in the Levant Sea, near the coast of Israel. The field of internal waves in tideless seas becomes quasistationary after approximately 10 hours, making it possible to formulate the necessary requirements for planning and conducting subsequent experiments specially directed to obtaining regional evaluations of the frequency of recurrence of internal waves. Figures 4; references 5: 4 Russian, 1 Western.

Features of Optical Structure and Interrelationship of Light Scattering Characteristics in Atlantic Ocean

[Article by A. P. Ivanov and A. A. Kumeysha, Physics Institute, Belarus Academy of Sciences, Minsk; UDC 551.463.5]

[Abstract] The results of measurements and analysis of observations of hydrooptical characteristics made during the 40th cruise of the Akademik Vernadskiy research ship are given. Two instruments were used: standard photometer-transparency meter and special scattering phase function meter. The first made it possible to determine the vertical profiles of the extinction index ε of directed radiation and the deep extinction index α, whereas the second ensured measurement of the absolute value of the index of directed scattering in the range of angles $1°$-$165°$ at a wavelength 530 nm. A whole series of other secondary scattering parameters was measured. Measurements were made in the North Sea, North Atlantic Current, in subpolar waters, in a meander zone and on a transatlantic run from Boston to Conakry and the distinctive information collected on each of these runs is summarized and interpreted. The interrelationships of the optical characteristics of different waters (such as scattering by large and small hydrosuspensions; molecular scattering; absorption by sea water, the pigments and yellow substance present in it) are discussed. Regression equations are derived for the interrelationships of the integral and angular light scattering parameters. This research was supplemented by nephelometric measurements, confirming and supplementing the other observations. Figures 2; references: 12 Russian.

Accumulation of Chemical Elements in Oceanic Ferromanganese Nodules

[Article by V. S. Savenko and G. N. Baturin, Moscow State University imeni M. V. Lomonosov; Oceanology Institute imeni P. P. Shirshov, Russian Academy of Sciences, Moscow; UDC 551.464.617]

[Abstract] A model of accumulation of metals in oceanic ferromanganese nodules (FMN) is examined. It is shown that the equilibrium constants of the sorption equilibrium reactions of metals are proportional to the values of the hydrolysis constants but are displaced relative to the latter by a value equal to the difference between the pH of pure water (7.0) and the pH of the isoelectric point of the mineral. This model is used in computing the concentrations of some uni- and bivalent metals in a dissolved state in sea water. It is shown that despite the low concentration of hydrogen ions H is the principal component adsorbed on the surface of manganese dioxide, whereas cations of the fundamental salts are secondary components. The results of the computations are consistent with experimental data. The computed distribution coefficients are given for pH 7.0 and 8.0. Although most of the materials in the article pertain to sorption phenomena, the principal role played in the formation of FMN is probably played by coprecipitation, with the interaction occurring with a far greater surface. The process of accumulation of metals in FMN may be extremely prolonged and may continue after formation of the collector phase. In accordance with the presented sorption model the entry of oxides into the crystal lattice differs from surface adsorption in that the absorbed metal does not interact with one, but with two hydroxyl groups. The importance of the work done by N. Takematsu, et al. in this field is emphasized. References 12: 5 Russian, 7 Western.

Some Prospects for Increasing Research Detail and Depth in Deep Seismic Sounding at Sea

[Article by S. Yu. Sokolov, Geology Institute, Russian Academy of Sciences, Moscow; UDC 550.834.04]

[Abstract] The possibilities for increasing the effective depth of the deep seismic sounding (DSS) method at sea by the accumulation of weak signals from pneumatic sources and achieving greater detail by exploiting better conditions for the superposition of signals from a group of pneumatic sources of different volume in the DSS frequency range are examined. Three aspects of this problem are examined in some detail: experiments for accumulation of weak seismic signals under marine conditions; estimating number of signal series necessary for discriminating weak deep waves by accumulation; shaping of broadband sounding pulses for increasing detail of DSS data. Some evidence of the possibilities of these approaches is illustrated by in situ registry of signals from pneumatic sources with chamber volumes 1, 0.5, 0.3 and 0.15 liter obtained at drift using a hydrophone at a depth 100 m. The following are necessary conditions for fully implementing these proposals: shipboard navigation systems with an accuracy in determining coordinates of a few tens of meters and better and flexible systems for controlling and monitoring a group of pneumatic sources with the possibility of changing the delays and periods of each radiating element of the group within a wide range. Only the use of new equipment and experimentation for improving the work method will make possible a real evaluation of the effectiveness of the proposed recommendations. Figures 3; references: 13 Russian.

Dynamics of Weakly Nonlinear Internal Waves in a Two-Layer Ocean

[Article by A. A. Borisov, G. A. Khabakhpashev; UDC 551.466]

[Abstract] This article applies a previously developed model to the case of waves in a two-layer liquid between a hard horizontal bottom and a ceiling and studies the effect of system parameters on the accuracy of solutions. In this model it is assumed that waves are characterized by weak nonlinearity. For linear waves propagating along the interface of a two-layer liquid, a polynomial approximation of a dispersion equation is proposed which has the identical asymptotics to an exact formula in the limit cases of very long and very short perturbations. In the case of three-dimensional weakly nonlinear waves with a slowly changing shape (in the coordinate system moving with the perturbation) a wave-like equation is obtained. This equation has Stokes solutions which coincide with known results for infinitely deep layers. For a sufficient perturbation length, separate solutions are determined for the model wave equation which agree well with experimental data. The differential equation which is derived here can be used to describe the evolution of internal waves for arbitrary layer depth relations and characteristic horizontal perturbation size. Figure 1; references 9: 7 Russian, 2 Western.

Manifestation of Subduction Process in Thermohaline Fields of Vertical Fine Structure and Horizontal Mesostructure in Azores Current Frontal Zone

[Article by V. M. Zhurbas, N. P. Kuzmina, R. V. Ozmidov, N. N. Golenko and V. T. Paka, Oceanology Institute imeni P. P. Shirshov, Russian Academy of Sciences, Moscow; UDC 551.465]

[Abstract] On the 46th cruise of the Dmitriy Mendeleyev (September- December 1991) a scanning probe was used in making an areal CTD survey of a part of the Azores Front with an interval between scannings of 2-3 miles. The purpose of the survey was to obtain the three-dimensional pattern of the thermohaline fields of the upper active layer of the ocean at the scales of the vertical fine structure and horizontal mesostructure (from one to tens of meters vertically and in the range from several kilometers to 100 km horizontally). It was postulated that an analysis of such measurements would make it possible to detect possible manifestations of the subduction process. The survey was made on six meridional runs 60-80 miles long in the layer 20-400 m with a distance 15 miles between adjacent runs. Meridional sections through a cyclonic meander revealed effects of accentuation and collapse of the front (an increase in horizontal thermohaline gradients in local regions of the upper layer of the thermocline with a width less than 5 km, a reversal of the sign on the slope of salinity isolines, a southward displacement of the salinity front in the upper mixed layer relative to its position in the underlying thermocline); on sections intersecting an anticyclonic meander such characteristics are absent. Maps of fine structure intensity (rms amplitude of vertical salinity inhomogeneities), computed for different layers

of the thermocline, allow interpretation within the limits of the subduction mechanism. Figures 5; references 4: 1 Russian, 3 Western.

Generation of Semidiurnal Internal Waves Over Submarine Ridge

[Article by V. I. Vlasenko and Ye. G. Morozov, Marine Hydrophysics Institute, Ukrainian Academy of Sciences, Sevastopol; Oceanology Institute imeni P. P. Shirshov, Russian Academy of Sciences, Moscow; UDC 551.446]

[Abstract] Three models (P. G. Baines, V. Vlasenko and nonlinear models) were used in an examination of the generation of intensive internal tidal waves in the neighborhood of a submarine ridge. The results of the mathematical simulation were compared with measurements made in the Mascarene Ridge region, which is noteworthy as an area where anomalous amplitudes of semidiurnal tidal waves have been registered, and good agreement was found. Under conditions of a strong barotropic tide and with a definite geometry of the ridge the amplitudes of the waves may be extremal. A favorable geometry of the ridge is one when the depth over the peaks is small, the depth of the ambient waters is great and the slopes are steep. A great number of modes is generated in the slope region which are summed into a ray structure. At some distance from the ridge the high modes dissipate and the entire thickness of the ocean is subject to oscillations only of the first mode. Due to the nonlinearity of the waves instead of a sinusoidal form of the wave a slope is formed with has a gentle leading and steep trailing edge. Upon attaining some critical parameters the trailing edge evolves into a packet of waves of short periods which carry the energy of the internal tidal wave. Figures 4; references 10: 6 Russian, 4 Western.

Nature of Intrathermocline Lens on Subpolar Front in North Atlantic

[Article by V. I. Byshev and V. S. Orlov, Oceanology Institute imeni P. P. Shirshov, Russian Academy of Sciences, Moscow; UDC 551.465.45]

[Abstract] An intrathermocline lens (ITL) ("AK-50") was discovered in June 1990 on the 50th cruise of the Akademik Kurchatov in the subpolar front in the North Atlantic to the east of Newfoundland; it was discussed in considerable detail in an article by V. A. Bubinov, et al. in DAN, Vol 317, No 2, pp 453-458, 1991). This represented the nucleus of an intrathermocline eddy. Numerical simulation was carried out to check the hypothesis of the possibility of a convective mechanism of generation of such an ITL using a one-dimensional differential- parametric model of the upper layer of the ocean. It is shown that anomalous disturbances of the

boundary conditions observed during the cold season 1985-1986 were capable of *[illegible]*, intensifying the development of convective mixing. The anomalous conditions of the ocean surface caused by the transport of cold add. By cover air masses into the region of the synoptic front *[illegible]* studied as external flows of apparent and latent heat from the ocean. intensive cooling and *[illegible]* of the radiad layer, an increase in its density and *[illegible]*, which is later in the most available factor responsible for generation of the "AK-III" III. The mass *[illegible]* conditions evident a developed in February 1986 on the relative porosity of the subpolar front. Figures 1 references 14: 10 Russian, 4 Western.

Use of Fluorimetric Lidar for Optical Measurements

[Article by E. I. Kantorov, S. A. Pakhomov and V. M. *[illegible]*, *[illegible]* Optical Institute, S. Petersburg *[illegible]*]

[Abstract] The influence of the vertical distribution of hydrooptical characteristics and the concentration of fluorescent substances on the signal of a fluorimetric lidar was studied within the framework of a two-flux approximation. The ascending light flux, proportional to the signal of the fluorimetric lidar, with an arbitrary stratification of the concentrations of substances *[illegible]* in any layer and with variations in the absorption and scattering indices is determined. The case examined is when the ascending flux is formed by directed laser radiation at the wavelength λ_e and by the ascending flux by the diffuse fluorescent component at the wavelength λ_f. Assuming that the fluorescence index is much less than the absorption index, *[illegible]* transfer equation for the local flux can thus be written in differential form. The effectiveness of use of the normalized fluorimetry signal based on measurements of the intensity of the Raman *[illegible]* is made was investigated in a quantitative spatial analysis of water media. It is concluded that normalization to the intensity of the Raman scattering in water in a general case does not make it possible to take into full account the influence of the hydrooptical *[illegible]* of the water medium on the signal of a fluorimetric lidar instrument with depth. Was studied. Primary *[illegible]* possible to evaluate and in whole process *[illegible]* about the influence of the hydrooptical *[illegible]*. Figures 2, references 5 Russian.

Research on Method for Using Excimer Laser for Measuring Thickness of Film of Petroleum Products on Water Surface

[Article by A. P. *[illegible]*, B. D. Lebedenko, S. A. Pakhomov and S. M. *[illegible]*, State Optical Institute *[illegible]* S. I. *[illegible]* 551-7.558.854]

[Abstract] An excimer laser is the most powerful and efficient light source in the UV range and the radiation wavelength λ_{ex} falls in the region of the absorption band of most typical petroleum products. A study was therefore made of the efficiency of use of an excimer laser in fluorimetric lidars for measuring the thickness of oil films on a water surface. Laboratory studies were made of the absorption spectra of petroleum products using an SF-46 spectrophotometer. The parameters of the spectral fluorescence band of petroleum products excited by an excimer laser is quite dependent on the type of petroleum product. For example, with transition from a relatively light petroleum product to a heavy product there is a long-wave shift of the spectral band by approximately 60 nm. The dependence of the lidar signal on film thickness also was computed. The research revealed that the proposed fluorimetric method with an excimer laser operating at $\lambda = 308$ nm can make possible remote highly efficient monitoring of the pollution of water bodies. Such a fluorimetric lidar makes it possible to classify such products on the basis of the form of the spectral fluorescence bands. The radiation wavelength of an excimer Xe-Cl laser falls in the spectral range of the maximum of the absorption band of petroleum products, which makes it possible to measure the thickness of thin films. Figures 3, references 9: 3 Russian, 6 Western.

Evaluation of Noise Immunity of Electric Measurements From Manned Sealab

[Article by V. A. Alekseyev and A. S. Lisin, Atomic Energy Institute Moscow, M. M. Boguslavskiy Institute of Earth Physics, Russian Academy of Sciences Moscow, L. T. Vanyan, Oceanology Institute imeni P. P. Shirshov, Russian Academy of Sciences Moscow UDC 551.465]

[Abstract] The most complete information on the geological-geophysical parameters of submarine sulfide deposits and the underwater hydrothermal springs forming them can be obtained from manned sealabs which carry electrode transducers for measuring constant and variable electric fields in the sea. Therefore an experimental study was made of the nature and intensity of the noise arising during field measurements from the Paysis-XI sealab while operating on the Kurils near Paramushir Island in July 1986. The graphite polarizing electrodes of the transducers were positioned at the prow and stern very close to its hull, about 4 m from one another. Signals in the band 0–13 Hz were registered by a magnetic recorder inside the sealab. Registry was during submergence, while sitting on the bottom and during maneuvering along the bottom. Samples of the records are reproduced and analyzed. The effectiveness of such sealabs for abyssal electrical measurements was demonstrated. The threshold responses of the electrode system are governed by sealab noise and in the frequency band 0.002 Hz cannot be greater than 10 μV/m when sitting on the bottom and 100 μV/m during maneuvers

... the bottom. Such measurement is not clearly of value ... ... Figure 1, references 2 Russian.

A New Class of Stationary Periodic Internal Waves on a Shear Flow

[Article by A. A. Minzhin, ... Institute of ... Physics, Russian Academy of Sciences, UDC ...]

[Abstract] This article examines the propagation of stationary periodic internal waves on the backround of a ... shear current. ...

Study of Sea Wave Slope Distribution Using Laser Scanning

[Article by ... V. V. Zavotin, K. A. Naugolnykh, ... Hydro... Acoustics Institute, UDC ...]

[Abstract] This article presents generalized data on the ... of sea wave slopes obtained by scanning ... onto the sea surface with a ... on board a research ship. ... It is shown that scanning provides additional information on the distribution of upper ... slopes of large waves. ...

... nonlinear ripple generation mechanism. The distribution of wave slopes is found to be nearly Gaussian at low wind speeds (3-7 m/s). At higher wind speeds and in regions with a perturbed current the situation is more complex. It was found that there is a link between slope values and the curvature of the sea surface. The data obtained here indicates that a decisive role is played by a mechanism which generates ripples on the slopes of gravity waves, and this is associated with nonlinear intensification of the crests of gravity waves. Ripple generation is more intense in steep waves. Figures 5, references 15, 11 Russian, 4 Western.

Spatial Fluctuations of Illuminance Under an Agitated Ocean Surface

[Article by Yu. Yu. Gorodetskiy, A. I. Kuznetsov, G. A. Maksimov, D. B. Rogozkin, Moscow Engineering-Physical Institute, UDC 551.463.5]

[Abstract] A consistent theory of the spatial fluctuations of illuminance under a real agitated sea surface is developed. The basic physical factors which determine the fluctuation characteristics are considered. A detailed ... is made of illuminance fluctuations for various models of an agitated surface. The effect of spatial coherence of the incident beam and multiple scattering and absorption of light in the water on the spectrum of fluctuations and the flickering index of underwater illuminance are analyzed. The role that various regions of the Pierson-Moskowitz wave spectrum play in the formation of spatial fluctuations of an underwater light field is studied. The limits of the application of the geometric-optics approximation are determined. The dependence of the spectrum of fluctuations in underwater illuminance on basic wave parameters and the optical characteristics of the water are determined (wind speed, scattering and absorption indices, etc.). New effects in the behavior of the flickering index and the fluctuation spectrum are predicted. A satisfactory agreement is obtained between theoretical results and experimental data. Figures 18, references 40, 32 Russian, 8 Western.

Integral Characteristics of the Echo Signal in Aerospace Laser Sounding of Sea Water Through an Agitated Surface

[Article by V. L. Vasov, L. A. Sergievskaya, Institute of Applied Physics, Russian Academy of Sciences, UDC 551.463.5]

[Abstract] The effect of double pass light propagation through a randomly rough interface on the characteristics of the echo signal is analyzed in laser sounding of the sea through a two-dimensional statically isotropic surface. The dependence of the depth-integrated signal and the integral characteristics (centroid and width) of a pulsed echo signal on the scattering properties of the water and wind velocity are studied. Graphs show the relation between the coefficient of backscattering amplification and sounding depth, receiving beam pattern, lidar height, and wind speed. Features and implications of these dependences are discussed. One original conclusion which is drawn is that one can determine the dispersion of the sea surface curvature from the maximum of the dependence of the average echo signal on sounding depth. It is found that the characteristics of the echo signal depend not only on the optical parameters of sea water, but also on the characteristics of surface wave motion. Figures 7; references 14 (Russian)

On the Dynamics of Hydrodynamic Turbulence

[Article by V. M. Vorobyev, G. A. Dobrovolskiy, Zaporozh State University, UDC 533.951.7]

[Abstract] This article describes turbulence in the framework of a system of equations for momenta. These equations typically present problems because they are nonlinear, and the resulting system of equations for the momenta of amplitudes of physical quantities is infinite and nonclosed. Here, in any medium with exponential nonlinearity this system is linear, infinite, and has a triangular matrix of equation right sides. Thus, interpretation becomes possible, and one can obtain a solution for the momentum. It is shown that the method used here makes it possible, with any degree of accuracy, to describe the dynamics of turbulence, and to obtain quantitative turbulence characteristics, i.e., turbulent viscosity and the stationary energy spectrum. References 9 (Russian)

Turbulent Transport of Radioactive Pollutant Due to Resuspension and Dry Precipitation

[Article by M. V. Buykov, Tayfun Scientific Production Association; UDC 551.551.8]

[Abstract] A study was made of the exchange of a pollutant between the quasistationary and homogeneous atmospheric surface layer and the underlying surface caused by wind resuspension and dry precipitation. A precise solution of the problem of exchange of a pollutant between the quasistationary surface layer and the underlying surface as a result of resuspension by the wind and precipitation of particles led to the conclusion that there is a steady quasistationary exchange regime. Since the parameters describing secondary pollutant transport processes may be dependent on the horizontal coordinates this fact may be responsible for the formation of the inhomogeneous structure of the surface field of the pollutant accompanying primary contamination. The solutions can have various applications: for evaluating the degree and rate of pollution of an initially clean area situated on the leeward side of the contaminated area, for formulating recommendations on experimental measurements of resuspension by the wind, for developing numerical methods for long-range prediction of evolution of the fields of pollution and for estimating the rate of "spreading out" of the pollution spot over long time intervals. It is noted that a model of these processes would be useful in studying events similar to the Chernobyl catastrophe. Figures 2, references 6: 2 Russian, 4 Western.

Simulation of Turbulent Diffusion of Pollutants With Short Propagation Times

[Article by A. I. Borodulin, Vektor Scientific Production Association; UDC 551.551.8]

[Abstract] The application of the semiempirical turbulent diffusion equation has a limitation related to the fact that the propagation time must be greater than the Lagrangian time scale of medium velocity pulsations. Replacing the traditional formulas and approach, a system of stochastic differential equations is proposed in which the pertinent processes are replaced by some centered, normal processes with known correlation functions having a nonzero correlation time. This is the basis for the proposed method. By making an examination of the coordinates of a "liquid particle" as the components of some multivariate Markov process and using a polynomial approximation of the real energy spectrum of medium velocity pulsations a new algorithm is written which is correct for any propagation times. This eliminates the above-mentioned limitation. Examples of use of the proposed method are examined. The proposed approach is a natural generalization of the method based on use of a semiempirical equation and additionally requires only a knowledge of the spectral characteristics of the field of medium velocity pulsations. Despite the increasing complexity of solution of the diffusion problem related to approximation of the spectral characteristics and the need for solving the multivariate Kolmogorov equation, the proposed method is of practical interest for the solution of problems in the diffusion of a pollutant in water bodies. References: 7 Russian.

Structure of Database of Space and Hydrometeorological Observations of Mesoscale Tropical Disturbances

[Article by I. N. Klepikov, I. V. Pokrovskaya and Ye. A. Sharkov, Space Research Institute, Russian Academy of Sciences, Moscow; UDC 528.8.041:551.509.57]

[Abstract] The principles for construction and a description of one of the variants of a geoinformation system developed at the Space Research Institute for use in studying the processes of evolution of large-scale atmospheric disturbances in different time stages from a background situation to the formation of a tropical disturbance to the last stages (decay) are presented. The initial information for the database must include the fields of temperature, humidity and kinematic meteorological parameters at convective, mesoscale and synoptic scales in order to form and investigate the informative geophysical parameters of the problem: spatial-spectral distribution of turbulent kinetic energy, spatial distribution of moist-static energy and spatial evolution of the large-scale (relative to the initial forms of a tropical disturbance) velocity field. The database organization must ensure referencing of the necessary meteorological information to the temporal dynamics (evolution) of a specific atmospheric formation. It is necessary to trace a so-called crisis phenomenon through all the stages of its development, including the earliest stages of formation, as well as the background conditions at the place of its future generation at the time of its generation, outward movement from this region and then along the entire trajectory of structure movement. The methods for formation of the computational architecture of the database must ensure independent selection and storage of all types of information to be incorporated into the unified information system with a possibility for independent and unlimited interrogation of the experimental data, sufficiently rapid retrieval and representation of any desired information fragment in a form convenient for the user and a sufficiently compact form of storage when using PC/AT-type personal computers for processing of space and surface hydrometeorological data. The use of a databank structured in accordance with these principles is illustrated for an area in the northwestern Pacific Ocean for three time periods during which tropical storms occurred. Figures 3; references 9: 8 Russian, 1 Western.

Formation of Acid Aerosol Trails in Atmosphere Behind Solid-Propellant Rockets

[Article by I. V. Alekseyeva and A. S. Kabanov, Tayfun Scientific Production Association; UDC 551.509.6:629.764.3]

[Abstract] Behind a rocket with a solid propellant acid trails may be formed from the combustion products. These trails consist of particles of an aqueous solution of hydrogen chloride which can be formed from the two-component vapor condensing on solid condensation nuclei of aluminum oxide present in great quantity in the combustion products of the solid rocket propellant. The composition of the combustion products of a number of space systems (Shuttle, Energiya, Titan and Proton) is compared. The aerosol trail is close to axisymmetric. The horizontal dimensions of such a trail at a given altitude first may increase somewhat, attain a maximum and then decrease to its total disappearance. The effect of the chemically active substances is determined in large part by the lifetime of the droplet trail and the maximum horizontal dimensions of the trail. The vertical profiles of the horizontal dimensions of acid aerosol trails and lifetimes of these trails are computed and a model is constructed on this basis whose results are confirmed by observational data showing that in Space Shuttle flights the acid aerosol trail acquires maximum horizontal dimensions (several kilometers) in the upper troposphere, near the tropopause level. In such tropospheric trails the quantity of acid aerosol predominates over gaseous HCl. Acid aerosol formations with the lifetimes determined in this study may enter into regions of formation of rain clouds and increase the acidity of the precipitation falling from them. One of the important local consequences of the launching of solid-propellant rockets is therefore the danger of the falling of acid precipitation. Figures 2; references 10: 3 Russian, 7 Western.

Model of Long-Term Transport of Radionuclides in River Channel

[Article by M. A. Novitskiy, Tayfun Scientific Production Association; UDC 556.114.679:556.536:556.5.072]

[Abstract] A mathematical model is proposed for estimating the rate of transport of long-lived radionuclides along rivers over long time periods. The model takes into account the principal mechanisms exerting an influence on the migration of radionuclides. The system consists of water and suspended matter, flowing along a river channel, and the layer of bottom deposits. The transport of radionuclides through the channel is accompanied by the following processes, taken into account in the model: sorption of radionuclides from the water by the suspended matter and accordingly desorption, precipitation of suspended matter onto the bottom, transport of water and suspended matter at the current velocity, dispersion of this transport by turbulence and current velocity shear, entry of suspended matter from the layer of bottom deposits due to stirring up of this layer and diffusion of water polluted by nuclides from the layer of bottom deposits. The following processes transpiring in the bottom layer also are taken into account: sorption and desorption of radionuclides by suspensions, entry of suspended matter due to precipitation from the channel and diffusion of radionuclides from the river channel into the water present in the layer of bottom deposits. It is shown that the rate of long-period transport of radionuclides is determined by the velocity of the river current and the coefficients of distribution of radionuclides in water-suspension and water-bottom deposits systems. The results of use of the model are compared with the results of observations of the migration of cesium-137 and strontium-90 in the Dnepr, there was good agreement between the computations and actual measurements. Figure 1; references: 4 Russian.

Air Pollution in Cities of Russian Federation in Comparison With Air Quality Criteria Proposed by World Health Organization

[Article by V. P. Andryukov and I. B. Pudovkina, Applied Geophysics Institute; UDC 504.3.054+504.064:574(047)(47+57)]

[Abstract] This article represents a continuation of an earlier study by the authors (METEOROLOGIYA I GIDROLOGIYA, No 7, 1992). Using WHO standards, an analysis was made for 1990 of air pollution in 255 cities in the Russian Federation (RF) by suspended matter and sulfur dioxide. The methods for measuring these pollutants are discussed, including the frequency and accuracy of the measurements. Particular attention is given to regional (European and Asiatic Russia) differences in dust pollution. In only 31 of the 255 cities in the RF did the mean annual dust levels not exceed the upper limit of the annual critical range. On the other hand, only seven cities in the RF were characterized by serious sulfur dioxide levels. The greatest one-time concentrations of sulfur dioxide were observed at Norilsk, Magnitogorsk and in settlements at the Astrakhan gas condensate complex. With respect to the joint pollution of air by sulfur dioxide and suspended matter, the most polluted cities in the RF during 1990 were Norilsk and Magnitogorsk. There the annual levels of atmospheric content of both pollutants were above the WHO critical ranges for the year period. The study of the two most commonly observed atmospheric anthropogenic pollutants therefore revealed that air pollution of most (88%) cities in the RF is characterized by considerable dust excesses. Figures 3; references 8: 6 Russian, 2 Western.

Method of Mapping Atmospheric Emissions From Industries in an Urban District (Using the Babushkinskiy Rayon, Moscow, as an Example)

N. M. Dronin, and L. V. Travina, Moscow Regional Laboratory, Department of Cartography and Geoinformation Science UDC 528.946(47+57-25)

[Abstract] A new method of mapping industrial atmospheric emissions in an urban district gives a meaningful initial assessment of the pollution hazard of individual enterprises. The map depicts the volume of pure air needed to dilute the daily emission of pollutant to the maximum acceptable concentration [MAC], rather than the total annual emission of pollutant from the source, as shown on prior maps. The formula for calculating this volume is modified for cases where the source emits more than one pollutant. The required volume of dilution air is shown in two dimensions representing a 0.5-km-thick layer of pure air. The emissions data for the maps were obtained from the "2TP-air" forms submitted annually by industrial enterprises. In the district under consideration, the largest source of total annual emissions was a petroleum-oil refinery, which released primarily hydrocarbons, sulfur dioxide, carbon monoxide, and nitrogen oxides. The smallest source was an umbrella factory, which released benzo[a]pyrene and lead oxides. When depicted by the new method, the umbrella factory is shown to require the largest volume of dilution air due to the very low MAC for benzo[a]pyrene, and thus represents the greatest pollution hazard in the district. This mapping method is not intended as a replacement for present calculation methods, but provides a rapid and inexpensive way of assessing the industrial pollution hazards in a district. Figures 2; references: 2 Russian.

Technogenic Heavy Metals and Arsenic in the Aerosols of Chimkent

T. M. Belyakova, and A. V. Kornilov, Department of Environmental Geochemistry and Soil Geography UDC 502.55(203)(574.53)

[Abstract] The goals of the study were to identify the sources of metal and arsenic aerosols in Chimkent, to determine the levels and geographic distribution of these pollutants, and to determine the diurnal variation and dynamics of the priority toxic aerosols. The extreme pollution problems in Chimkent are the result of the large number of technogenic pollution sources combined with unfavorable climatic conditions: frequent light winds, strong low-level inversions, and light precipitation. The primary source of metal aerosols is the Chimkent lead smelter [ChMZ]. Three-day series of simultaneous air samplings were taken at various distances from the smelter in June 1985 and June 1986. Although amounts of the individual pollutants varied from year to year, the relative abundance was the same: $Ca > Fe > Pb > Zn \geq Mn > Cu > As \approx Ni$. Compared with the local background levels (measured at the Repetekskiy Biosphere Preserve), Pb levels are 100 and 15 times higher for 1985 and 1986, respectively, As levels are 56 and 19 times higher, Cu levels are 17 and 2.4 times higher, and Mn levels are 10 and 2.7 times higher. The major pollutant was consistently Pb, with levels up to 25-50 times the maximum acceptable concentration. Maximum Pb levels were found within 1.5 km of the smelter. Smelter emissions affected the entire city. A combination of methods was used to identify the pollution sources: the coefficient of technogenic enrichment of aerosols, the diurnal variations of metal aerosols and dust, and an analysis of metal concentration vs. wind direction. Correlation analysis showed that the lead smelter is the principal source of Pb, Zn, and As. The partially coal-fired power plant is an additional source of Cu and Ni, the cement plant is a source of Ca, and the phosphorus plant is a source of Cu. The least technogenic metals in the Chimkent atmosphere are Fe, Mn, and Ca, which are obtained primarily from soil and rock deflation. The priority pollutant is Pb. The Pb, Zn, As, and Cu levels vary widely, with the highest levels occurring during heavy industrial emissions combined with light southwest winds. Figures 1; references 6 Russian.

Measurement of the Surface Concentration of Ozone and Nitrogen Oxides in Moscow

[Article by Ye. A. Kadyshevich, N. F. Yelanskiy, Institute of Atmospheric Physics, Russian Academy of Sciences; UDC 551.510.41]

[Abstract] Results are presented of the measurement of ozone and nitrogen oxide concentrations in the center of Moscow. Additional ozone concentrations are provided for a site in the suburbs (60 km from the center of Moscow). Measurements were taken during May-June 1990 and February 1991. The frequency distributions of average hourly values and average daily patterns are compared for the two periods. It is noted that values exceeding the maximum permissible concentration of ozone were not observed in the average hourly values. The nitric oxide concentration exceeded the maximum permissible concentration once in eight hours. An interrelation among all measured values is examined, as well as their connection to total solar radiation. The specific conditions of sample collection are described. The average ozone concentration in Moscow in summer was 14 ppb, and in winter 9 ppb. The analogous figures for the suburban site were 24 and 18 ppb. The nitrogen oxide figures were 17 ppb in the summer and 20 ppb in the winter. Figures 3; tables 3; references 14: 4 Russian, 10 Western.

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